

CLAIMS

What is claimed is:

1. A viscoelastic polyurethane foam having a density of from one to thirty pounds per cubic foot, said foam comprising a reaction product of:

5 an isocyanate component;

an isocyanate-reactive component;

a chain extender having a backbone chain with from two to eight carbon atoms and a weight-average molecular weight of less than 1,000, wherein said chain extender is used in an amount of from 5 to 50 parts by weight based on 100 parts by weight of said foam; and

10 said foam having a glass transition temperature of from 5 to 65 degrees Celsius and a tan delta peak of from 0.40 to 1.75.

2. A viscoelastic polyurethane foam as set forth in claim 1 wherein said chain extender is used in an amount of from 5 to 30 parts by weight based on 100 parts by weight of said foam.

3. A viscoelastic polyurethane foam as set forth in claim 2 wherein said chain extender has a weight-average molecular weight of from 25 to 250.

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4. A viscoelastic polyurethane foam as set forth in claim 1 wherein said chain extender is used in an amount of from 5 to 15 parts by weight based on 100 parts by weight of said foam.

25 5. A viscoelastic polyurethane foam as set forth in claim 4 wherein said chain extender has a weight-average molecular weight of less than 100.

6. A viscoelastic polyurethane foam as set forth in claim 1 wherein said chain extender has two isocyanate-reactive groups.

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7. A viscoelastic polyurethane foam as set forth in claim 6 wherein said chain extender is a diol having hydroxyl groups as said isocyanate-reactive groups.

8. A viscoelastic polyurethane foam as set forth in claim 1 wherein said chain
5 extender is further defined as having from two to six carbon atoms.

9. A viscoelastic polyurethane foam as set forth in claim 8 wherein said chain
extender is selected from at least one of 1,4-butanediol, 1,3-butanediol, 2,3-butanediol,
1,2-butanediol, 1,3-propylene glycol, and 1,5-pentanediol.
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10. A viscoelastic polyurethane foam as set forth in claim 9 wherein said chain
extender is selected from at least one of ethylene glycol, diethylene glycol, and
polyethylene glycols having a weight-average molecular weight of up to 200.

11. A viscoelastic polyurethane foam as set forth in claim 9 wherein said foam
has a glass transition temperature of from 15 to 35 degrees Celsius and a tan delta peak
of from 0.9 to 1.5.
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12. A viscoelastic polyurethane foam as set forth in claim 1 wherein said
20 isocyanate component is further defined as:

pure diphenylmethane diisocyanate in an amount of from 50 to 99 parts by
weight based on 100 parts of said isocyanate component; and

polymeric diphenylmethane diisocyanate in an amount from 1 to 50 parts
by weight based on 100 parts of said isocyanate component.
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13. A viscoelastic polyurethane foam as set forth in claim 12 wherein said pure
diphenylmethane diisocyanate is further defined as:

diphenylmethane-2,4'-diisocyanate in an amount of from 1 to 45 parts by
weight based on 100 parts of said pure diphenylmethane diisocyanate; and

diphenylmethane-4,4'-diisocyanate in an amount from 55 to 99 parts by weight based on 100 parts of said pure diphenylmethane diisocyanate.

14. A viscoelastic polyurethane foam as set forth in claim 13 wherein said
5 isocyanate component is further defined as an isocyanate-terminated prepolymer.

15. A viscoelastic polyurethane foam as set forth in claim 14 wherein said prepolymer comprises a reaction product of an isocyanate and a polyol having a weight-average molecular weight greater than 1,000, said polyol being used in an amount of
10 from 1 to 20 parts by weight based on 100 parts of said isocyanate component.

16. A viscoelastic polyurethane foam as set forth in claim 1 wherein said reaction product further comprises a cross-linker in an amount of from 2 to 18 parts by weight based on 100 parts by weight of said foam.
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17. A viscoelastic polyurethane foam as set forth in claim 16 wherein said cross-linker is further defined as being an amine-based cross-linker.

18. A viscoelastic polyurethane foam as set forth in claim 17 wherein said
20 amine-based cross-linker is selected from at least one of triethanolamine, diethanolamine, ethylene diamine and alkoxylation product thereof having a hydroxyl number of greater than 250.

19. A viscoelastic polyurethane foam as set forth in claim 1 wherein said
25 isocyanate-reactive component comprises a polyol selected from at least one of polyether polyols and polyester polyols.

20. A viscoelastic polyurethane foam as set forth in claim 19 wherein said polyol has a hydroxyl number of from 20 to 200 mg KOH per gram of said polyol.
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21. A viscoelastic polyurethane foam as set forth in claim 1 wherein said reaction product further comprises a monol in an amount of from 1 to 15 parts by weight based on 100 parts by weight of said foam.

5 22. A viscoelastic polyurethane foam as set forth in claim 21 wherein said monol is selected from at least one of benzyl alcohol, 2,2-dimethyl-1,3-dioxolane-4-methanol, and alcohol ethoxylate.

10 23. A viscoelastic polyurethane foam as set forth in claim 1 wherein said reaction product further comprises a cell opener having at least one of a paraffinic, cyclic, and aromatic hydrocarbon chain and is present in an amount of from 1 to 15 parts by weight based on 100 parts by weight of said foam.

15 24. A viscoelastic polyurethane foam as set forth in claim 23 wherein said cell opener is mineral oil.

25. A composition for use in forming a viscoelastic polyurethane foam having a density of from one to thirty pounds per cubic foot, said composition comprising:

20 an isocyanate component substantially free of toluene diisocyanate;
 an isocyanate-reactive component; and
 a chain extender having a backbone chain with from two to eight carbon atoms and a weight-average molecular weight of less than 1,000, wherein said chain extender is present in an amount of from 5 to 50 parts by weight based on 100 parts by weight of said composition.

25 26. A composition as set forth in claim 25 wherein said chain extender is present in an amount of from 5 to 30 parts by weight based on 100 parts by weight of said composition.

27. A composition as set forth in claim 26 wherein said chain extender has a weight-average molecular weight of from 25 to 250.

28. A composition as set forth in claim 25 wherein said chain extender is present in an amount of from 5 to 15 parts by weight based on 100 parts by weight of said composition.

29. A composition as set forth in claim 28 wherein said chain extender has a weight-average molecular weight of less than 100.

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30. A composition as set forth in claim 25 wherein said chain extender has two isocyanate-reactive groups.

31. A composition as set forth in claim 30 wherein said chain extender is a diol having hydroxyl groups as said reactive groups.

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32. A composition as set forth in claim 25 wherein said chain extender is further defined as having from two to six carbon atoms.

33. A composition as set forth in claim 32 wherein said chain extender is selected from at least one of 1,4-butanediol, 1,3-butanediol, 2,3-butanediol, 1,2-butanediol, 1,3-propylene glycol, and 1,5-pentanediol.

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34. A composition as set forth in claim 32 wherein said chain extender is selected from at least one of ethylene glycol, diethylene glycol, and polyethylene glycols having a weight-average molecular weight of up to 200.

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35. A composition as set forth in claim 25 wherein said isocyanate component is further defined as:

pure diphenylmethane diisocyanate present in an amount of from 50 to 99 parts by weight based on 100 parts of said isocyanate component; and

5 polymeric diphenylmethane diisocyanate present in an amount from 1 to 50 parts by weight based on 100 parts of said isocyanate component.

36. A composition as set forth in claim 35 wherein said pure diphenylmethane diisocyanate is further defined as:

10 diphenylmethane-2,4'-diisocyanate present in an amount of from 1 to 45 parts by weight based on 100 parts of said pure diphenylmethane diisocyanate; and

 diphenylmethane-4,4'-diisocyanate present in an amount from 55 to 99 parts by weight based on 100 parts of said pure diphenylmethane diisocyanate.

15 37. A composition as set forth in claim 25 wherein said isocyanate component comprises an isocyanate-terminated prepolymer.

38. A composition as set forth in claim 37 wherein said prepolymer comprises a reaction product of an isocyanate and a polyol having a weight-average molecular weight
20 greater than 1,000, said polyol present in an amount of from 1 to 20 parts by weight based on 100 parts of said isocyanate component.

39. A composition as set forth in claim 38 wherein said composition further comprises a cross-linker in an amount of from 2 to 18 parts by weight based on 100 parts
25 by weight of said composition.

40. A composition as set forth in claim 39 wherein said cross-linker is further defined as being an amine-based cross-linker.

41. A composition as set forth in claim 40 wherein said amine-based cross-linker is further defined as being selected from at least one of triethanolamine, diethanolamine, and ethylene diamine.

5 42. A composition as set forth in claim 25 wherein said isocyanate-reactive component is further defined as being a polyol selected from at least one of polyether polyols and polyester polyols.

43. A composition as set forth in claim 42 wherein said polyol has a hydroxyl
10 number of from 20 to 200 mg KOH per gram of said polyol.

44. A composition as set forth in claim 25 wherein said composition further comprises a monol present in an amount of from 1 to 15 parts by weight based on 100
15 parts by weight of said composition.

45. A composition as set forth in claim 44 wherein said monol is selected from at least one of benzyl alcohol, 2,2-dimethyl-1,3-dioxolane-4-methanol, and alcohol
ethoxylate.

20 46. A composition as set forth in claim 25 wherein said composition further comprises a cell opener selected having at least one of a paraffinic, cyclic, and aromatic hydrocarbon chain and is present in an amount of from 1 to 15 parts by weight based on 100 parts by weight of said composition.

25 47. A composition as set forth in claim 46 wherein said cell opener is mineral oil.

48. A method of forming a viscoelastic polyurethane foam comprising the steps
of:

30 providing an isocyanate component substantially free of flame retardant;

providing an isocyanate-reactive component;

providing a chain extender having a backbone chain with from two to eight carbon atoms and a weight-average molecular weight of less than 1,000, wherein the chain extender is used in an amount of from 5 to 50 parts by weight based on 100 parts
5 by weight of the foam; and

reacting the isocyanate component, the isocyanate-reactive component, and the chain extender to form the foam having a glass transition temperature of from 5 to 65 degrees Celsius and a tan delta peak of from 0.40 to 1.75.

10 49. A method as set forth in claim 48 wherein the step of providing the chain extender is further defined as providing the chain extender in an amount of from 5 to 30 parts by weight based on 100 parts by weight of the foam.

50. A method as set forth in claim 49 wherein the step of providing the chain
15 extender is further defined as providing the chain extender having a weight-average molecular weight of from 25 to 250.

51. A method as set forth in claim 48 wherein the step of providing the chain extender is further defined as providing the chain extender in an amount of from 5 to 15
20 parts by weight based on 100 parts by weight of the foam.

52. A method as set forth in claim 51 wherein the step of providing the chain extender is further defined as providing the chain extender having a weight-average
25 molecular weight of less than 100.

53. A method as set forth in claim 48 wherein the step of providing the chain extender is further defined as providing the chain extender having two isocyanate-reactive groups.

54. A method as set forth in claim 53 wherein the step of providing the chain extender is further defined as providing the chain extender as a diol having hydroxyl groups as the isocyanate-reactive groups.
- 5 55. A method as set forth in claim 48 wherein the step of providing the chain extender is further defined as providing the chain extender having from two to six carbon atoms.
- 10 56. A method as set forth in claim 55 wherein the step of providing the chain extender is further defined as providing the chain extender selected from at least one of 1,4-butanediol, 1,3-butanediol, 2,3-butanediol, 1,2-butanediol, 1,3-propylene glycol, and 1,5-pentanediol.
- 15 57. A method as set forth in claim 56 wherein the step of providing the chain extender is further defined as providing the chain extender selected from at least one of ethylene glycol, diethylene glycol, and polyethylene glycols having a weight-average molecular weight of up to 200.
- 20 58. A method as set forth in claim 57 wherein the step of reacting the isocyanate component, the isocyanate-reactive component, and the chain extender forms the foam having a glass transition temperature of from 15 to 35 degrees Celsius and a tan delta peak of from 0.9 to 1.5.